J Microbiol Immunol Infect
2004;37:45-49

Pediatric lung abscess: a retrospective review of 23 cases

Chen-Chieh Yen[1,2], Ren-Bin Tang[1], Shu-Jen Chen[1], Tai-Wai Chin[3]

Department of Pediatrics [1]Taipei Veterans General Hospital and National Yang-Ming University, Taipei and [2]Hsin-Chu Hospital, Department of Health, The Executive Yuan, Hsin-Chu; [3]Department of Pediatric Surgery, Taipei Veterans General Hospital and National Yang-Ming University, Taipei, Taiwan, ROC

Received: September 18, 2002 Revised: March 10, 2003 Accepted: May 6, 2003

Pulmonary abscess is a rare but critical problem in childhood. We did a retrospective review of 23 children with documented lung abscess who had been admitted and treated at the Taipei Veterans General Hospital over a 20-year period from April 1982 to April 2002. Among the 23 children, 11 cases were primary lung abscess, and 12 were secondary lung abscess. The pathogens were isolated in 16 patients (69.6%), and blood cultures yielded in only 3 patients (13.0%). The most common microorganism isolated in this series was *Streptococcus pneumoniae.* The 2 patients (8.7%) that died in our series had secondary lung abscess. We herein report the presenting symptoms, bacteriology, clinical management, and outcome of these 23 cases.

Key words: Lung abscess, microbiology, pediatric, therapy

Lung abscess is a localized area of necrotic material in the parenchyma of the lung that is initiated or complicated by infectious organisms. Pulmonary abscess occurs more rarely in children than in adults. Despite the availability of new antimicrobial agents and advanced diagnostic techniques, lung abscess is still capable of causing substantial morbidity in children. Only a few cases of this pediatric problem have been reported in Taiwan [1,2]. We conducted a retrospective review of lung abscess patients admitted during a recent 20-year period at Taipei Veterans General Hospital (VGH).

Materials and Methods

From April 1982 to April 2002, 23 patients (less than 16 years old) with lung abscess were admitted to VGH. A lung abscess was defined as a process of suppuration resulting in the destruction of the lung parenchyma and formation of a cavity containing purulent material. All cases were referred either by community hospitals or local medical doctors. Cases of bronchiectasis, infected congenital lung cyst, and pneumonia without definite abscess formation were excluded from this series. A primary lung abscess has been defined as an abscess that is present in a previously healthy patient with no underlying disorder, whereas a secondary abscess is defined as an abscess in a patient with an underlying or predisposing condition.

Medical charts in the medical records department were reviewed, and 28 patients were initially identified, using ICD-9 coding, as having a discharge diagnosis of lung abscess. Twenty-three cases had radiographic evidence (chest radiograph and/or chest computerized tomography scan) compatible with the diagnosis of lung abscess, and 5 patients without a lung abscess were excluded from the study (2 lobar pneumonia, 3 lobar pneumonia with empyema). Information was obtained regarding gender, age, presenting symptoms, underlying conditions, diagnostic image results, microbiological data, treatment regimen, antibiotics therapy, and operative management. Non-operative management was defined as antibiotic therapy exclusively or with the performance of any percutaneous drainage procedure. Operative management indicated the procedures, such as thoracotomy, lobectomy, or decortication. Patients were considered recovered if they became afebrile, improved clinically, and showed a continued radiographic improvement in the lung abscess.

Results

Twenty-three patients were identified with lung abscesses over a 20-year period from April 1982 to April 2002. Among the 23 cases, 13 were referred by community hospitals, and 10 were referred by local

Corresponding author: Dr. Ren-Bin Tang, Department of Pediatrics, Taipei Veterans General Hospital, 201, Shih-Pai Road, Section 2, Taipei, Taiwan 11217, ROC.
E-mail: rbtang@vghtpe.gov.tw

medical doctors. Ages ranged from 4 months to 16 years (median, 7.6 years). Twelve of the patients were males and 11 were females. Eleven of the 23 patients had primary lung abscesses, while 12 had secondary abscesses. The underlying conditions included immunodeficiency in 5 (3 with immunoglobulin G4 deficiency, 2 with T cell function impairment), a neurogenic condition in 2 (2 with cerebral palsy), an oncologic condition in 2 (1 with acute myeloid leukemia, M4 type, the other with acute undifferentiated leukemia), foreign body aspiration in 1 (guava seed), congenital lung anomaly in 1 (congenital anomaly of the right upper lobe orifice), and chromosomal anomaly in 1 (Down's syndrome).

In comparing the primary lung abscess with the secondary abscess in our series, the mean age was found to be younger in the primary abscess group (5.1 ± 5.4 vs 10.4 ± 5.8 years), but the mean hospital stay was longer in the secondary abscess group (24.0 ± 10.3 vs 37.2 ± 33.2 days). All patients who died belonged to the secondary lung abscess group.

The most common presenting symptoms were fever, cough, and dyspnea. All symptoms are listed in Table 1. The patients with primary lung abscess had no history of choking or aspiration before the development of the abscess. In our series, abscess occurred throughout the year without seasonal predominance.

In all study cases, the radiographic features were compatible with lung abscess (chest radiography and/or chest computerized tomography scan). Air-fluid levels were revealed in 13 patients. Involvement most commonly occurred in the right upper lobe (47.8%), followed by the right lower lobe (39.1%), the right middle lobe (39.1%), the left lower lobe (21.7%), and the left upper lobe (13.0%). Eleven patients (47.8%) had involvement of more than 1 pulmonary lobe. Twenty of the 23 patients (87.0%) had a pleural effusion associated with their lung abscess.

Table 1. Symptoms and signs of patients with lung abscess (n = 23)

Symptom/sign	No. of cases (%)
Fever	21 (91.3)
Cough	20 (87.0)
Dyspnea	8 (34.8)
Anorexia	6 (26.1)
Rhinorrhea	6 (26.1)
Nausea/vomiting	6 (26.1)
Purulent sputum	6 (26.1)
Lethargy	5 (21.7)
Acute otitis media	4 (17.4)
Diarrhea	3 (13.0)
Headache	3 (13.0)
Sore throat	3 (13.0)
Abdominal pain	3 (13.0)
Chest pain	2 (8.7)
Hemoptysis	2 (8.7)
Convulsion	2 (8.7)
Irritability	2 (8.7)
Cyanosis	2 (8.7)

Table 2. Pathogens isolated from 23 patients with lung abscess

Microorganism	Lung abscess	
	Primary	Secondary
Aerobic		
Gram-positive cocci		
Streptococcus pneumoniae[a]	5	1
Staphylococcus aureus[b]	1	1
Gram-negative bacilli		
Pseudomonas aeruginosa	2	3
Klebsiella pneumoniae	0	1
Moraxella catarrhalis	0	1
Acinetobacter baumannii	0	1
Samonella enteritidis group D	0	1
Anaerobic		
Prevotella intermedia	0	1
Fungus		
Candida albicans	0	1
Candida glabrata	0	1
Aspergillus sp.	0	1
No growth	5	2

[a]Included 3 isolates of penicillin-resistant strain in primary lung abscess and 1 in secondary lung abscess.
[b]All isolates were oxacillin-resistant.

In this study, 21 organisms were isolated from 16 patients, as illustrated in Table 2. The most common microbe isolated in the primary lung abscesses was *Streptococcus pneumoniae*; *Pseudomonas aeruginos*a was most common in the secondary lung abscesses. Anaerobes were isolated in only 1 patient, and fungi were isolated in 3 patients. Five patients had mixed infections with ≥2 organisms, and no organism was isolated in 7 patients. Twelve of the organisms were isolated from the pleural effusion, 7 from the operated tissue specimen, 3 from the blood culture, and 1 from a pure sputum culture. The 3 microorganisms isolated from the blood were *S. pneumoniae, Salmonella enteritidis* group D, and *Aspergillus*. The only anaerobe (*Prevotella intermedia)* isolated was from a case of cerebral palsy with a history of aspiration. All patients with fungi had underlying conditions [acute myeloid leukemia (AML), 1; AML, M4, 1; T cell function impairment, 1]. In the 10 patients referred by local medical doctors, 7 had isolated organisms. On the other

hand, 9 of the 13 patients referred by community hospitals had isolated organisms. No obviously different culture positive rates were found in these 2 groups.

All patients were initially treated with antibiotics after admission. Twenty-two (95.7%) of the 23 patients were treated with 2 or more antibiotics. Only 1 patient was treated with monotherapy.

Nine patients (39.1%) were managed non-operatively with antibiotics therapy alone or in combination with a percutaneous drainage procedure, which included placement of a chest tube in 7 patients, bronchoscopic interventions in 4 patients (3 for bronchoalveolar lavage, 1 for removal of a foreign body), echo-guided chest tapping in 2 patients, and the placement of a pigtail drainage in 1 patient. The average length of inpatient therapy was 17.5 days (range, 4 to 43 days). Fourteen patients (60.9%) required additional operative management. The indication for surgical treatment was the failure of non-operative treatment, which was apparent clinically by persistent sepsis, and radiographically by a persistence or expansion of the abscess. Surgical treatment included the following: thoracotomy with lobectomy (3 of 14); thoracotomy with decortication (3 of 14); and thoracotomy with lobectomy and decortication (8 of 14). One patient had a prolonged air leak after the lobectomy, and was treated successfully with a prolonged period of chest tube drainage. The average length of hospitalization before performing surgery was 18.5 days. The average length of hospital stay was 42.5 days (range, 14 to 120 days).

Twenty-one patients (91.3%) ultimately recovered, while 2 patients died. The 2 patients who died had an underlying condition (1 cerebral palsy and 1 acute undifferentiated leukemia). The deaths occurred secondary to respiratory failure; 1 received an operation and the other did not.

Discussion

A lung abscess is an area of necrotic material in the parenchyma of the lung that is initiated or complicated by infectious organisms. It is uncommon in infants and children. Lung abscesses are classified into primary and secondary in origin by some authors [3,4], inasmuch as the predisposing events, management, and prognosis are different in these 2 groups. We illustrated the clinical, microbial isolates, and outcome findings of 3 major groups as well as our series of pediatric lung abscesses (Table 3) [3,5,6]. All the mortalities in the 4 series, including ours, were due to secondary lung abscess.

Lung abscesses have a tendency to develop in any part of the lung. If the abscess is associated with aspiration, the most frequent sites of abscess formation are the dependent sites in the recumbent position: the right upper lobe, the left lower lobe, and the apical segment of both lower lobes [7]. In general, there is a tendency for aspiration-related abscesses to develop more on the right side than on the left, presumably due to the more vertical angle of the right stem bronchus [6]. The right upper lobe was most commonly involved in these patients.

The microbiology of lung abscesses involves aerobes, anaerobes, and fungi. Most lung abscesses related to aspiration are polymicrobial, and include anaerobes. In the present series, isolates were polymicrobial in 5 patients. The primary role of anaerobes in lung abscesses has been assumed in aspiration pneumonia. However, in many past studies, lung abscess materials have not been sampled and

Table 3. Clinical, laboratory, treatment, and outcome findings of 4 major groups of patients with lung abscess

	1956-1965 [3]	1982-1993 [5]	1985-1990 [6]	1982-2002 [present study]
Total no. of lung abscesses	83	45	28	23
Median age	-	8.5 years	9 years	7.6 years
No. of primary lung abscesses	25	15	18	11
No. of secondary lung abscesses	58	30	10	12
No. of males (%)	53 (63.9)	23 (51.1)	15 (53.6)	11 (47.8)
Predominant organism isolated (no.)	*S. aureus* (52)	*Bacteroides* spp. (8)	*S. aureus* (6)	*S. pneumoniae* (6)
No. of patients with isolated microbes (%)	-	34 (75.6)	13 (46.4)	16 (69.6)
No. of blood cultures isolated (%)	-	1 (2.2)	3 (10.7)	3 (13.0)
No. of patients with mixed infections with ≥2 organisms (%)	-	14 (31.1)	0	5 (21.7)
No. of anaerobes isolated (%)	0	15 (33.3)	0	1 (4.3)
No. of patients receiving lobectomy (%)	4 (4.8)	7 (16.7)	8 (28.6)	11 (47.8)
No. of deaths (%)	54 (65.1)	5 (11)	1 (3.6)	2 (8.7)

cultured for optimal anaerobic growth. Brook and Finegold [8] demonstrated that anaerobes play a significant role in pediatric lung abscesses that were evaluated with transtracheal aspiration; 74 institutionalized pediatric patients with aspiration pneumonia all had anaerobes in their lower airway. Brook and Finegold [9] reported 10 pediatric patients evaluated with percutaneous transtracheal aspiration before the initiation of antimicrobial therapy. Anaerobes were present in all 10 patients. In this study, only 1 patient with cerebral palsy and a history of aspiration was isolated with anaerobes. Successful growth has been described when the specimens are transported in a closed syringe with a culture inoculation in less than 10 minutes [9]. *Peptostreptococcus* and *Bacteroides* species were the anaerobes discovered most frequently [9]. The importance of anaerobes in lung abscesses cannot be established from our data. Nevertheless, we believe that anaerobes are highly significant in the pathogenesis of lung abscesses in patients with a history of aspiration.

Previous reports have shown that the most common aerobes leading to lung abscess include *Staphylococcus aureus, S. pneumoniae,* and enteric Gram-negative bacilli [3,10,11]. Another series reported from Taiwan showed a significantly higher incidence of *S. pneumoniae* and *S. aureus* in a primary group [2]. In this study, *S. pneumoniae* was the major bacteria in primary lung abscesses, while Gram-negative bacilli, especially *P. aeruginosa*, was the major pathogen causing secondary lung abscesses.

In a report by Tan and associates [5], fungal abscesses had underlying conditions, such as malignancy and immunodeficiency. Morton et al [12] reported an immunodeficient child with aspergillus lung abscess**.** Rubin and Alroy [13] reported a patient with an oncologic disorder and a *Candida* lung abscess. In our study, all fungal lung abscesses had underlying conditions such as leukemia and T cell function impairment.

The most common presenting symptoms in pediatric lung abscesses are cough, fever, tachypnea, dyspnea, chest pain, vomiting, sputum production, weight loss, and hemoptysis [3,4,7,9,14,15]. Currently, the diagnosis of lung abscess is almost always made by imaging the lung. A chest radiographic film is adequate to establish the diagnosis. The use of computed tomography is helpful in distinguishing between an abscess and a bronchogenic cyst, and has a better anatomic definition [16-18].

The initial choice of treatment for lung abscesses is conservative management. The initial choice of antimicrobial agent is always empirical because abscess material may not be available. For primary lung abscesses, it is recommended to begin with the antibiotics that cover *S. aureus, S. pneumoniae*, and Gram-negative bacilli that are normally found in the upper respiratory tract. Penicillin, ampicillin plus sulbactam or amoxicillin plus clavulanic acid, and third-generation cephalosporin or aminoglycoside are frequently prescribed [19]. For patients at risk for aspiration, antibiotics should cover anaerobes normally found in the upper airway. Clindamycin coverage must be considered. For patients who are immunocompromised, the possibility of fungal infection increases, and antifungal agents might be used [19]. When the culture data are available, antimicrobial agents could be shifted for the isolated pathogen. However, in most patients, oral or intravenous antibiotics that have been administrated before the culture specimen was obtained may affect the organisms being isolated [6]. For this reason, antibiotic treatment should cover the pathogen that is not isolated (such as anaerobes in aspiration).

Draining the abscess may be required for a patient with persistent fever and toxicity after 7 to 10 days of appropriate antimicrobial therapy. The procedures most commonly used are catheter drainage or needle aspiration with fluoroscopy, ultrasonography, or computed tomography [17,20-24].

Some surgeons recommend that a surgical procedure should be reserved for patients with very severe lung abscesses and those who fail to manifest clinical and radiologic evidence of improvement after appropriate intravenous antibiotic therapy [5,6,25]. For the many pediatric lung abscesses that do not respond to medical treatment and simple drainage procedures, surgical intervention is indicated, and can shorten the hospital stay [1]. In the present series, the indication for surgical treatment was the failure of conservative treatment (antibiotics alone or in combination with a percutaneous drainage procedure), which was apparent clinically by the persistent sepsis, and radiographically by a persistence or expansion of the lung abscess.

The prognosis of pediatric lung abscesses is usually very good when the lung abscesses are uncomplicated, and recovery is more rapid in children than in adults [26]. In this study, the patients with primary lung abscess demonstrated complete recovery. The patients that died had secondary abscesses, usually to their primary disorder. Asher et al [7] found that all 11 primary abscess

patients, followed for a mean of 8 years after their acute illness, had normal pulmonary function, except for 1 with asthma antedating the abscess. Nonoyama et al [27] found normal pulmonary function in patients studied post-lobectomy. Few of our patients were studied using pulmonary function testing, but complete radiologic and clinical cures were very common.

References

1. Wu MH, Tseng YL, Lin MY, Lai WW. Surgical treatment of pediatric lung abscess. Pediatr Surg Int 1997;12:293-5.
2. Tseng YL, Wu MH, Lin MY, Lai WW, Liu CC. Surgery for lung abscess in immunocompetent and immunocompromised children. J Pediatr Surg 2001;36:470-3.
3. Mark PH, Turner JA. Lung abscess in childhood. Thorax 1968; 23:216-20.
4. McCracken GH Jr. Lung abscess in childhood. Hosp Prac 1978; 13:35-6.
5. Tan TQ, Seilheimer DK, Kaplan SL. Pediatric lung abscess: clinical management and outcome. Pediatr Infect Dis J 1995; 14:51-5.
6. Emanuel B, Shulman ST. Lung abscess in infants and children. Clin Pediatr 1995;34:2-6.
7. Asher MI, Spier S, Beland M, Coates AL, Beaudry PH. Primary lung abscess in childhood: the long-term outcome of conservative management. Am J Dis Child 1982;136:491-4.
8. Brook I, Finegold SM. Bacteriology of aspiration pneumonia in children. Pediatrics 1980;65:1115-20.
9. Brook I, Finegold SM. Bacteriology and therapy of lung abscess in children. J Pediatr 1979;94:10-2.
10. Bartlett JG, Gorbach SL, Tally FP, Finegold SM. Bacteriology and treatment of primary lung abscess. Am Rev Respir Dis 1974;109:510-8.
11. Bartlett JG, Finegold SM. Anaerobic infections of the lung and pleural space. Am Rev Respir Dis 1974;110:56-77.
12. Morton JR, Mihalas LS, Leung P, Strieder DJ. Corticosteroids and malnutrition. Aspergillus lung abscess in an asthmatic child. Chest 1980;78:667-9.
13. Rubin AH, Alroy GG. Candida albicans abscess of the lung. Thorax 1977;32:373-6.
14. Moore TC, Battersby JS. Pulmonary abscess in infancy and childhood: report of 18 cases. Ann Surg 1960;151:496-500.
15. Groff DB, Rapkin RH. Primary lung abscess in childhood. J Med Soc N J 1974;71:649-52.
16. Stark DD, Federle MP, Goodman PC, Podrasky AE, Webb WR. Differentiating lung abscess and empyema: radiography and computed tomography. AJR Am J Roentgenol 1983;141: 163-7.
17. Mayer T, Matlak ME, Condon V, Shasha I, Glasgow L. Computed tomographic findings of neonatal lung abscess. Am J Dis Child 1982;136:39-41.
18. Johnson JF, Shiels WE, White CB, Williams BD. Concealed pulmonary abscess: diagnosis by computed tomography. Pediatrics 1986;78:283-6.
19. Wheeler JG, Jacobs RF. Lung abscess. In: Feigin RD, Cherry JD, eds. Textbook of pediatric infectious diseases. 4th ed. Philadelphia: Saunders; 1998:301-7.
20. Cuestas RA, Kienzle GD, Armstrong JD. Percutaneous drainage of lung abscesses in infants. Pediatr Infect Dis J 1989; 8:390-2.
21. Levine MM, Ashman R, Heald F. Anaerobic (putrid) lung abscess in adolescence. Am J Dis Child 1976;130:77-81.
22. Lorenzo RL, Bradford BF, Black J, Smith CD. Lung abscesses in children: diagnostic and therapeutic needle aspiration. Radiology 1985;157:79-80.
23. Parker LA, Melton JW, Delany DJ, Yankaskas BC. Percutaneous small bore catheter drainage in the management of lung abscesses. Chest 1987;92:213-8.
24. vanSonnenberg E, D'Agostino HB, Casola G, Wittich GR, Varney RR, Harker C. Lung abscess: CT-guided drainage. Radiology 1991;178:347-51.
25. Powell KR. Primary pulmonary abscess. Am J Dis Child 1982; 136:489-90.
26. Neild JE, Eykyn SJ, Phillips I. Lung abscess and empyema. Q J Med 1985;57:875-82.
27. Nonoyama A, Tanaka K, Osako T, Kotani S, Kagawa T. Surgical treatment of pulmonary abscess in children under ten years of age. Chest 1984;85:358-62.